PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Elongated Flexible Magnet Systems

We, THE B.F. GOODRICH COMPANY, a corporation organised under the laws of the State of New York, United States of America, of 230 Park Avenue, New York, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Refrigerators, especially those of the type used in the home, employ a gasket or sealing means between the door and the body of the cabinet to cushion the door in closing, prevent the passage of air when the door is closed and provide a heat insulating barrier in this region. These gaskets are generally formed of rubber, synthetic plastic material, or other elastomeric materials which have rubber-like properties so they can deform under pressure and thereby provide a seal between the cabinet and door even though there be irregularities in the surfaces of these members. Heretofore, it has been customary to form the gasket of a material and in a configuration such that considerable pressure is required to deform the gasket sufficiently to provide efficient sealing action around the entire door opening. This has made it necessary to utilize door latches which produce a strong clamping force. In an effort to avoid the need for such latches, attempts have been made to employ door gaskets requiring only a light compressive force to effect confirmation to the surfaces engaged, this force being supplied by magnetic means. Although such magnetic door gaskets have many advantages over the conventional combination of latch and stiff gasket, nevertheless, they have not received wide acceptance. This is partly because the gaskets, in some cases, have not provided the necessary sealing action but, more importantly, because the cost of manufacture has been excessive, owing to the high cost of producing the system of magnets required.

In accordance with the method of the present invention, an elongated flexible magnet system is provided by causing an elongated magnetizable strip to adhere, in face to face contact, to an elongated flexible strip and by transversely breaking up the magnetizable strip, at spaced locations along the length of the strips, into discrete blocks so that the composite strip is rendered flexible, and by magnetizing the magnetizable material. Such a method is a cheap and convenient one to carry out and the flexible system produced may be handled as a unit. Thus, this unit may be inserted lengthwise into a chamber extending along the length of an elongated strip of resilient, flexible, gasket material and of substantially the same length as the system, and the system may then be secured in place in the chamber to leave a gap between a face of the system and a chamber wall. The magnet system then serves to provide a light compressive force for urging together the two parts which are to be sealed by the gasket, whilst the provision of a gap between a face of the system and the chamber wall permits the gasket material readily to distort to effect a good seal.

The invention also includes the elongated flexible magnet system itself, comprising an elongated flexible strip, and, adhering to it in face to face contact, a magnetizable strip which has been broken up into discrete blocks and magnetized.

In the accompanying drawings which illustrate a magnet system according to the invention;

Fig. 1 is a perspective view of a portion of a strip of magnet-forming material employed in practicing the invention;

Figs. 2A and 2B, when joined on the dot-dash lines AA^1 and BB^1, comprise a schematic representation of the apparatus and steps employed in making an improved magnet system for a gasket;

Fig. 3 is a plan view of a portion of the supported magnetic material produced by the apparatus and manipulations illustrated in Figs. 2A and 2B;

Fig. 4 is a fragmentary perspective view of a resilient gasket of flexible material which

[*Price*

may be provided with the magnet system illustrated in Fig. 3, the near end of the view being in transverse section;

Fig. 5 is a fragmentary plan view of a portion of a gasket as shown in Fig. 4 provided with a magnetic system as shown in Fig. 3 with parts of the gasket being broken away to further illustrate the nature of the completed gasket strip and the procedural steps followed in its manufacture; and

Fig. 6 is a fragmentary front elevational view of a domestic refrigerator with the open door thereof provided with a gasket having a magnet system constructed in accordance with the invention.

Efficient sealing action between the cabinet and door of the refrigerator requires that the gasket assembly has a high order of flexibility so that it can accommodate to irregularities on the cooperating surface of the cabinet and door. Hence, the material and the configuration thereof employed for the gasket must be such that the latter is flexible and easily resiliently deformed. When the gasket contains magnets, they should be so arranged that the magnetic attraction is substantially uniform at all locations along the gaskets and this must be achieved without excessive loss of flexibility of the assembly. These requirements make it imperative that there be a large number of small closely adjacent magnets within the gasket. The production of such a magnet-containing gasket has been difficult to achieve by known procedures.

The magnets employed in the illustrated gasket are formed from finely-divided magnet-forming material united by a binder and shaped into an elongated strip which is then divided into discrete blocks. Preferably, the magnet-forming material is a ferrite and the binder is a synthetic resin. The particular ferrite and resin employed, as well as the percentages thereof, can, of course, be varied but the presently preferred composition, in terms of the weights of the components, is one comprising 90% ferrite and 10% vinyl resin. The resin may include a plasticizer in sufficient quantity to facilitate handling of the mixture as hereinafter explained.

The magnet-forming material and binder are thoroughly mixed and subjected to sufficient heat and pressure to form an elongated strip 10, as illustrated in Fig. 1. This can be effected by providing the ferrite and resin in powder form which are mixed, milled, granulated and then extruded by conventional machinery of the type employed for fabricating synthetic resins. Apparatus of this type is well-known and, hence, need not be illustrated. As here shown, the strip 10 is rectangular in cross section with a width of approximately 1/2 inch and a thickness of approximately 1/8 inch. These dimensions are not critical, however, and the cross-sectional shape and dimensions are selected in accordance with the desired dimensions of the completed gasket.

The strip 10 may be led from the extruder or other apparatus in which it is formed directly through the subsequent operations which incorporate it as a part of a complete gasket, or the strip may be produced and subsequently incorporated into a gasket in two or more separate operations. The strip 10, when cooled after forming, has sufficient transverse flexibility that it can be coiled on a drum or reel without breaking provided the diameter thereof is large enough so that the strip is not subjected to small radius bending. However, the strip is sufficiently fragile so that it can be readily broken by notching or scoring and then bending it in an arc of small radius.

The strip 10 is converted into a plurality of small magnets and prepared for incorporation into a resilient gasket by a sequence of operations somewhat schematically illustrated in Figs. 2A and 2B. As there shown, the strip 10 of magnet-forming material is disposed upon a reel 11 from which it is led over a guide wheel 12 that has side flanges to prevent run-out of the strip. From the guide wheel 12 the strip 10 moves into contact with, and is adhered in face-to-face contact to, a supporting elongated strip 13 of flexible material which is supplied from a reel or drum 14 and is guided into aligned relationship with the strip 10 by a suitable guide wheel or pulley 15. The strip of magnet-forming material 10 and flexible strip 13 are placed in superposed contact by passing between a pressure roll 16, which is preferably covered with rubber or other resilient material, and a notching wheel 17. The notching wheel 17 is formed of rigid material and has knife-like projections 18 extending radially therefrom at spaced locations about its periphery. The radial extent of the projections 18 is less than the thickness of the strip 10 so that the latter is provided with spaced transversely extending cuts or notches without separation of the strip into separate units.

The flexible strip 13 is provided with an adhesive substance and is fed with that substance on the side which contacts the strip 10 so that the two strips are adhered by their passage between the wheel or roll 16 and the notching wheel 17. Without limitation thereto, one suitable type of supporting strip 13 is a film of synthetic material, for example, a polyester, regenerated cellulose, or the like, coated with a pressure-sensitive adhesive. Thus, the strip 13 may be one of the commercially available pressure adhesive tapes. Alternatively, the strip 13 may be provided with a suitable adhesive just prior to its engagement with the strip of magnet-forming material.

After the magnet-forming strip 10 has been supported and notched, the composite strip then moves into contact with a belt 19 which is trained about a large diameter wheel or

pulley 20. The composite strip engages the belt 19 with the notched surface of the strip 10 contacting the belt and with the supporting film or strip 13 on the external surface. In its passage from the notching wheel 17 to the wheel 20, the composite strip is supported by a guide wheel 21 similar to the guide wheel 12.

The guide wheels 12 and 21 are mounted by means, not shown, which permits adjustment of their axes of rotation in directions parallel to a line formed by the centers of the wheels 16 and 17. This enables the path of the strip 10 in its passage about the wheel 17 to be so regulated that the unnotched surface of the strip is under tension and thus slightly elongated when the strip 13 is supplied thereto. The positions of the wheels 12 and 21 are so selected, in accordance with the dimensions and composition of the strip 10, that the tension and resulting elongation of the unnotched surface will provide the proper spacing of the discrete blocks into which the strip 10 is subsequently divided as hereinafter explained. Because the flexible strip 13 is outermost as the composite strip passes around the wheel or pulley 20, the strip 13 and the adjacent surface of the strip 10 are under tension. This tightens the strip 13 upon the strip 10 and tends to slightly further elongate the strip 10.

The composite strip is next carried by the belt 19 in a reverse curve around a smaller diameter break wheel or pulley 22 with the flexible strip 13 adjacent this wheel. The parts are so positioned that the composite strip is in contact with the wheel 22 through approximately 1/3 of its peripheral extent with the strip supported by the belt 19 so that the composite strip is held in engagement with the wheel. During this portion of its movement the strip of magnet-forming material is broken into discrete units or blocks 23. These are retained in adhesive engagement with the strip 13 but the blocks are spaced slightly adjacent their bases by virtue of the forces produced by passage of the strips 10 and 13 about the wheels 17, 21, 20 and 22 in the described sequence.

The several reels and wheels or pulleys thus far described are rotatably supported upon a suitable frame which is here shown as a vertically disposed plate P. Motion is imparted to the separate strips 10 and 13, and to the composite strip formed therefrom, by a driving means comprising a motor 24 and speed reduction unit 25. The output shaft of the unit 25 is provided with a pulley 26 which drives a belt 27 that is trained about and rotates a pulley 28 connected with the wheel 20 by the shaft 29. In the illustrated embodiment the supply reels for the strip materials and the pulleys or wheels over which the strips are led are located on one side of the supporting frame P with the driving means on the opposite side. This prevents interference between the strips and the driving mechanism.

The motion imparted to the wheel 20 by the driving means is transmitted to the composite strip through contact with the belt 19 which, as shown in Fig. 2A, extends around the wheel or pulley 20 and an idler wheel or pulley 30 with the break wheel 22 disposed between the pulleys 20 and 30 in a position such that the belt 19 is deflected in a reverse curve with the composite strip in engagement with the periphery of the break wheel for a substantial proportion of its arcuate extent. The tension imparted to the composite strip by virtue of the driving of belt 19 and wheel 20 is sufficient to move both the magnet-forming strip and the flexible strip 13 from their supply reels and to cause rotation of the wheel 16 and the notching wheel 17. However, if desired, additional driving means can be supplied for rotating the wheels 16 and 17 and separate feeding mechanisms can be employed for the strip 10 and also for the supporting film or tape 13. Appropriate driving and feeding mechanisms are conventional and their construction and use are well-known so that they need not be described or illustrated.

As the result of passing about the break wheel 22, the strip 10 is fractured at the location of each notch or scratch so that the strip is now in the form of discrete units or blocks 23 slightly spaced from each other. These blocks or units are, however, maintained in continuous strip form by virtue of the supporting strip or film 13. The spacing imparted to the units is made possible by the application of the strip 13 while the adjacent surface of the strip 10 of magnet-forming material is elongated, due to the adjustment of the guide wheels 12 and 21 as well as by the tightening of the strip 13 and the other forces exerted upon the composite strip during its passage about the wheels 20 and 22. The division of the strip 10 into separate blocks or units renders the composite strip sufficiently transversely flexible to permit it to readily conform to irregular surfaces when employed in a resilient gasket, as hereinafter explained.

In the particular method illustrated, the composite strip with the magnet-forming material in the form of discrete blocks or units 23 is next passed through a magnetic field to magnetize the blocks so that these become permanent magnets. The configuration of the magnetic field imparted to the blocks may be selected in accordance with the nature and degree of holding power required for the magnets. Thus, they may be magnetized with the adjacent ends of the separate blocks of either like or unlike polarity, or they may have opposite poles along the longitudinal edges, or each block or unit may have several sets of magnetic poles. The desired arrangement of the magnetic poles can be effected by employing an electrically energized magnetizer or mag-

netizing unit of known construction, which is here schematically indicated at 31. The unit 31 has a magnetizing field of proper configuration for the selected arrangement of poles, which field is momentarily energized through a condenser discharge so that a high intensity field of short duration is applied to the magnet-forming material.

The momentary application of the magnetic field is preferably effected while the composite strip is momentarily stationary within the field of force of the magnetizing means 31. This may be effected by employing a mechanism for moving the composite strip in a step-by-step motion and timing the energization of the magnetic field in synchronism with the movement of the material. The mechanism by which such an operation may be effected is schematically shown in Fig. 2B as comprising a conveyor belt 32, which is driven by an intermittent motion mechanism 33 through a belt 34 connecting the conveyor with a pulley on the output shaft of the mechanism 33. This mechanism 33 may be of any desired construction as, for example, that employing a Geneva motion operated by an electric motor 35. Synchronism of the operation of the magnetizing means 31 with the operation of the conveyor is achieved by providing a star wheel or rotary cam 36 upon one side of the head pulley for the conveyor 32, which cam operates a switch 37 that controls the magnetizing means.

The magnetizing means 31 and the conveyor 32 are so located relative to the break wheel 22 that sufficient slack can occur in the composite strip to provide for the fact that the strip is only intermittently moved beneath the magnetizing means, whereas it is continuously passing from the break wheel 22. That is to say, the spacing of the parts and the speed of operation are such that, when the conveyor 32 is stationary, the continuous movement of the break wheel 22 and of the driven wheel 20 produces a loop or slack in the composite strip, which loop or slack is substantially removed when the composite strip is moved by the conveyor 32. The construction of the cam 36 is such that as the conveyor 31 comes to rest, the switch 37 will be operated to cause energization of the magnetic means 30 and the latter is not in operation during the time when the conveyor 32 is moving the strip of material.

The operations described in conjunction with the apparatus schematically shown in Figs. 2A and 2B produce a composite strip of discrete magnetized blocks supported upon a flexible backing as shown in Fig. 3. The next step of the process is to incorporate a length of this strip into the tubular chamber or cushion portion of a resilient gasket. The gasket may be formed of rubber, vinyl, or other elastomeric material in a variety of different configurations. One suitable type, designated 38, is shown in Figs. 4 and 5 as comprising a base or attachment flange portion 39 and an integral longitudinally extending tubular portion or cushion 40 which provides a chamber that is approximately crescent shape in cross section and is sufficiently thin walled to readily deform under light pressure. The dimensions of the chamber in the cushion portion 40 of the gasket are such that the composite strip is accommodated therein with a gap between the upper face of the magnet system (i.e. the tops of the magnetic blocks) and the outer wall of the gasket.

The insertion of a length of the composite strip material into the tubular or cushion portion 40 of the gasket may be effected by a variety of different procedures. For example, the gasket may be held substantially vertically and the composite strip dropped therein. Alternatively, the gasket may be placed in a substantially horizontal position and the composite strip pulled therethrough by a suitable member of cross sectional dimension less than that of the tubular portion 40 of the gasket. In either case, the operation is facilitated by the presence of the backing or supporting strip 13 which allows a plurality of discrete blocks 23 of magnetic material to be handled as a single unit.

After the composite strip has been inserted within the hollow chamber of the gasket, it is secured therein to the lower or base wall 41 of the chamber in the tubular portion 40 by any suitable expedient. As here shown, the strip is thus secured by allowing the supporting strip 13 to extend slightly beyond the end magnetic blocks 23 and stapling this extending portion to the wall 41. In place of stapling, a suitable adhesive or other means of fastening may be employed.

A plurality of lengths of resilient gasket material, supplied with the composite strips including the magnetic blocks, may be assembled into a complete gasket for refrigerators or other cabinets by uniting such strips into a rectangular or other configuration corresponding to that of the opening in the cabinet which is to be sealed. As shown in Fig. 6, the refrigerator cabinet 42 is provided with a door 43 to which is secured a rectangular gasket 44, each side of which is formed by one length of magnet-containing resilient gasket material of the type shown in Fig. 5. The union of the separate lengths of the gasket into a rectangular configuration of this type is preferably effected by mitering the adjacent ends so that they can be heat sealed together in substantially right-angle relationship. The mitering and uniting operation is facilitated by first inserting into the ends of the tubular portion 40 of each separate length of the gasket a short length or plug 45 of heat insulating material such as glass wool. These plugs provide a support for the walls of the hollow portion of the gasket thus facilitating cutting and

uniting of the end portions. In addition, the plugs 45 somewhat stiffen the corners of the gasket thus preventing undesirable deformations thereof when attached to the door 43.

The refrigerator 42 or other cabinet provided with a magnet-containing gasket such as 44 does not require a latch to hold the door in closed position. This follows from the fact that the cabinets of refrigerators are conveniently made of steel and, hence, when the door with the gasket 44 is moved to a position in which the door substantially closes the opening to the cabinet, the magnetic attraction between the magnetic blocks 23 and the material of the cabinet 42 causes the door to be completely closed. Moreover, an effective seal is provided between the door and cabinet since the gasket is compressed or deformed by the attempts of the magnetic blocks to move into intimate contact with the cabinet 42. The flexible nature of the gasket material and the fact that the magnetic material is in the form of short discrete blocks permits the gasket to conform with surface irregularities of the cabinet and the door thus making an effective seal without the need of a strong clamping force. Moreover, the nature and construction of the magnet-containing gasket insures uniform sealing pressure throughout its entire extent in contrast to the forces exerted upon a conventional gasket when it is deformed by a door which is closed and secured by a single mechanical latch. Furthermore, the effective sealing action of the gasket is achieved with an increase of safety over that possible with mechanically operated latches since the door can be as easily opened from the interior as from the exterior.

The production of magnet-containing gaskets as described can be economically effected so that these gaskets can compete with conventional gaskets and latching means heretofore employed. This is made possible by the fact that the formation of the separate blocks comprising the magnets in the completed gasket requires a minimum of hand operations and employs relatively inexpensive materials. Furthermore, it is unnecessary to provide a specially designed resilient gasket for receiving the magnets so that the best features of heretofore known gasket configurations can be employed.

WHAT WE CLAIM IS:—

1. A method of making an elongated flexible magnet system, in which an elongated magnetizable strip is caused to adhere, in face to face contact, to an elongated flexible strip and is transversely broken up, at spaced locations along the length of the strips, into discrete blocks so that the composite strip is rendered flexible, and in which the magnetizable material is magnetized.

2. A method according to claim 1, in which the magnetizable and flexible strips are continuously fed from respective spools and brought together for a continuous adhering process to be effected.

3. A method according to claim 2, in which the breaking up process precedes the magnetizing process, which latter process is performed by feeding the composite strip forward in steps past a magnetizer which provides the magnetizing field for the blocks only when the composite strip is stationary.

4. A method according to any of the previous claims, in which the magnetizable material is a finely divided ferrite united by a plastic binder.

5. A method according to claim 4, in which the binder is a synthetic resin.

6. A method according to claim 5, in which the resin is a vinyl resin.

7. A method according to any of the previous claims, in which the magnetizable strip is broken up into blocks by transverse notching at spaced locations along the length of the strip on the face remote from the flexible strip and then bending the composite strip with the notches on the outside of the bend.

8. A method according to claim 7, in which, during the adhering process, the composite strip is bent, with the flexible strip on the outside of the bend, so that the part of the magnetizable strip adjacent the flexible strip is placed in tension and readily splits up at the notches during the subsequent bending operation.

9. A method of making a magnetic gasket, in which an elongated, flexible magnet system made by a method according to any of the previous claims, is inserted lengthwise into a chamber extending along the length of an elongated strip of resilient, flexible, gasket material and of substantially the same length as the system, the system then being secured in place in the chamber to leave a gap between a face of the system and a chamber wall.

10. A method according to claim 9, in which the magnet system is secured in place by securing it to the chamber wall opposite the gap.

11. A method of making a composite magnetic gasket for sealing around the periphery of an opening, in which a number of gaskets, each made by a method according to either claim 9 or claim 10, are secured to one another end to end to make up a continuous and closed composite gasket.

12. A method according to claim 11, in which prior to being secured together, the ends of the individual gaskets are all open and are filled with deformable insulating material so that the junctions between the individual gaskets are reinforced by this material.

13. An elongated flexible magnet system comprising an elongated flexible strip and, adhering to it in face to face contact, a magnetizable strip which has been broken up into discrete blocks and magnetized.

14. A system according to claim 13, in which the blocks are made of a finely divided

ferrite united by a plastic binder.

15. A system according to claim 14, in which the binder is a synthetic resin.

16. A system according to claim 15, in which the resin is a vinyl resin.

17. A magnetic gasket comprising a system according to any of claims 13 to 16 disposed lengthwise in a chamber extending along the length of an elongated strip of resilient, flexible, gasket material and of substantially the same length as the system, the system being secured in place in the chamber to leave a gap between a face of the system and a chamber wall.

18. A gasket according to claim 17, in which the magnet system is secured to the chamber wall opposite the gap.

19. A composite gasket comprising a number of gaskets according to claim 17 or claim 18 secured end to end to form a continuous and closed composite gasket for sealing around the periphery of an opening.

20. A composite gasket according to claim 19, in which the junctions between the individual gaskets are reinforced from within by deformable insulating material.

21. A method according to claim 1, substantially as described with reference to Figs. 2A and 2B of the accompanying drawings.

22. A method according to claim 9, substantially as described with reference to Figs. 3 to 5 of the accompanying drawings.

23. A system according to claim 13, substantially as described with reference to Fig. 3 of the accompanying drawings.

24. A gasket according to claim 17, substantially as described with reference to Figs. 4 and 5 of the accompanying drawings.

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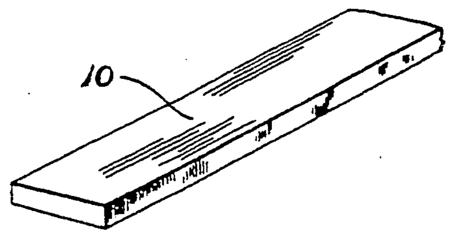

FIG. 1

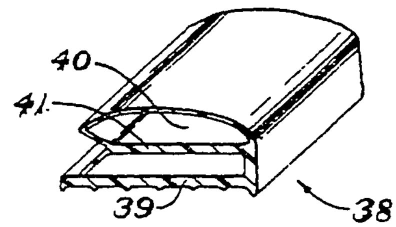

FIG. 4

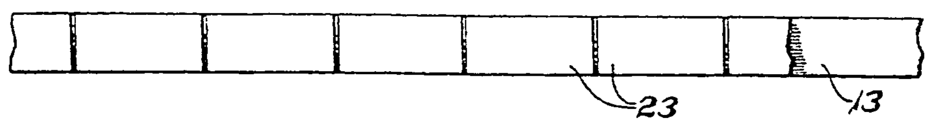

FIG. 3

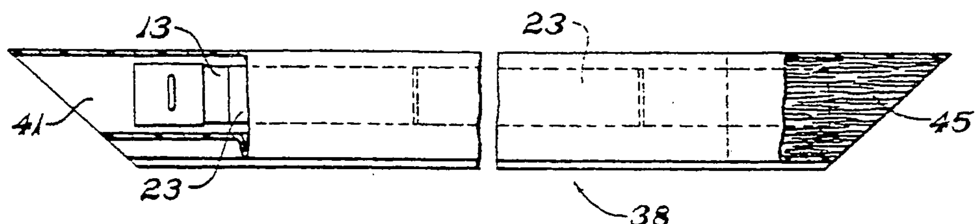

FIG. 5

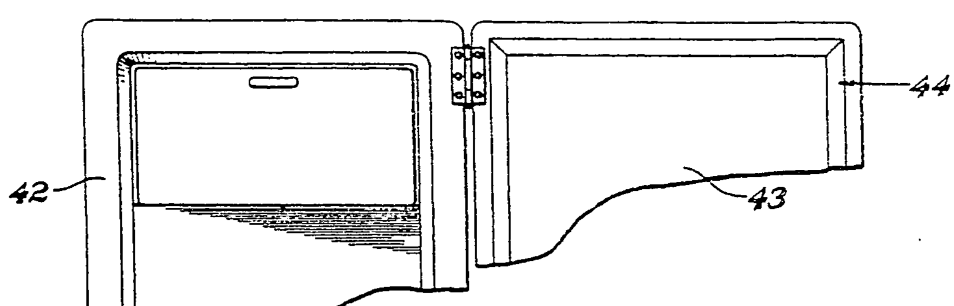

FIG. 6

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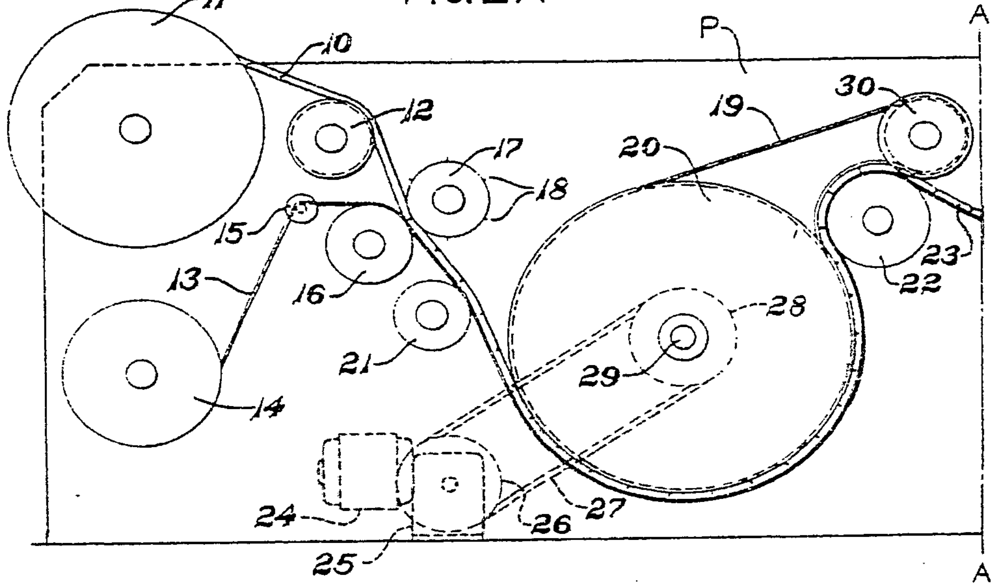
SHEETS 1 & 2

Fig. 2A



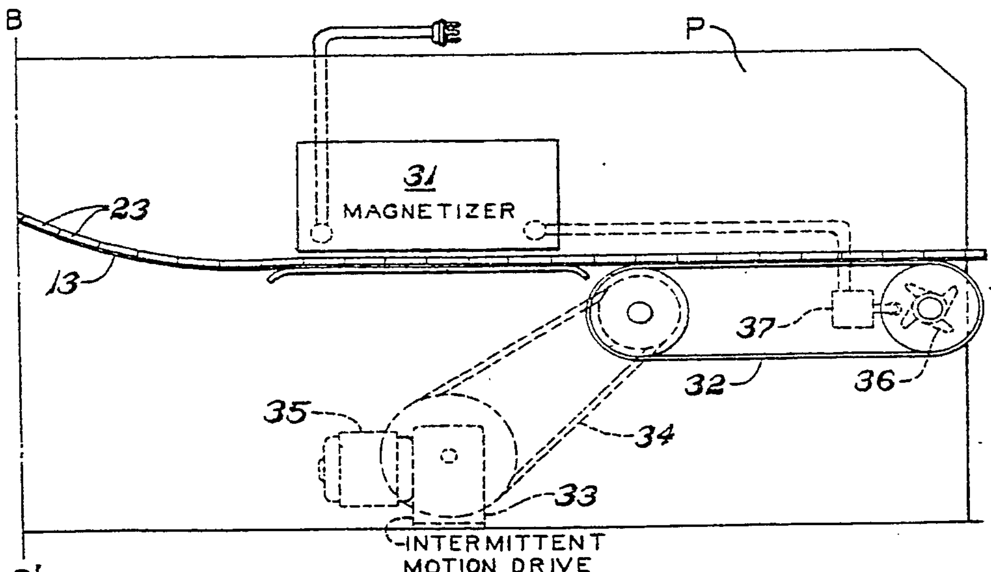


Fig. 2B

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2 SHEETS
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SHEETS 1 & 2

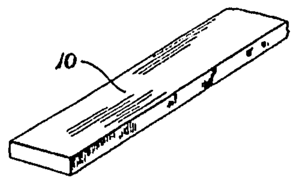


FIG. 1

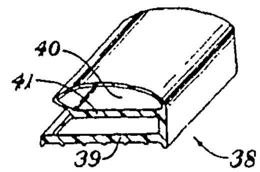


FIG. 4

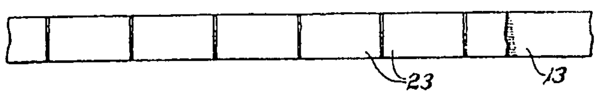


FIG. 3

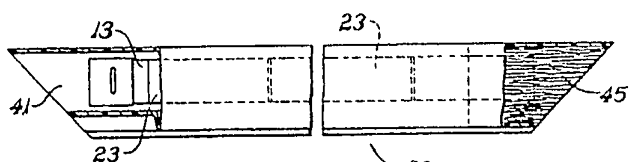


FIG. 5

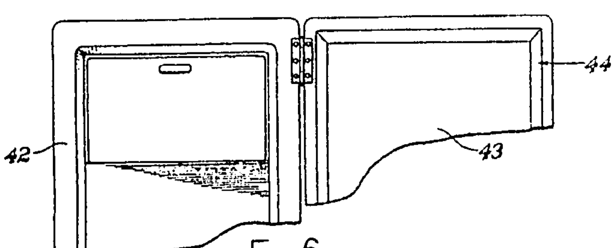
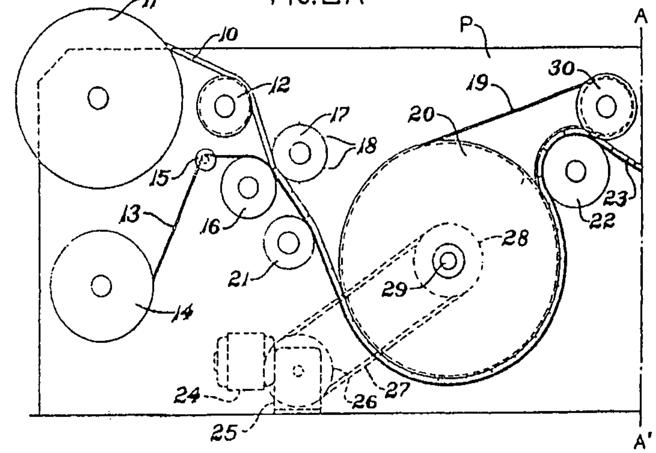


FIG. 6

FIG. 2A



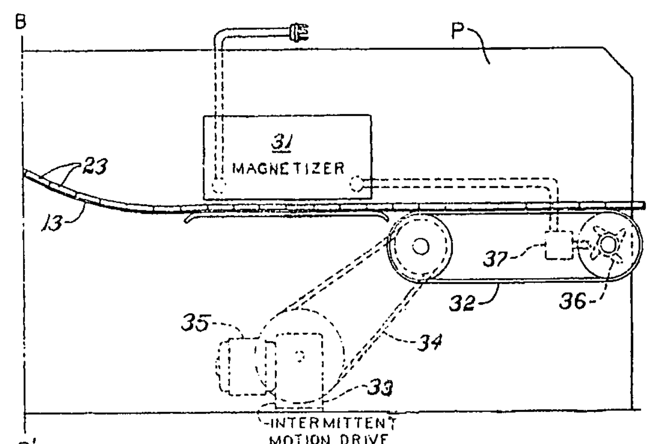


FIG. 2B